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MACD - ANALYSIS OF WEAKNESSES OF THE MOST POWERFUL TECHNICAL ANALYSIS TOOL

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ABSTRACT

Due to the huge popularization of the stock trading amongst youth, in the recent years more and more of trading and brokerage houses are trying to find a one 'easy to understand' tool for the novice traders. Moving average convergence divergence seems to be the main pick and unfortunately inexperienced traders are relying on this one tool for analysis and trading of various securities. In this paper, I will investigate the validity of MACD as the 'magic wand' when solely used in investment trading decision making. The main limitation of this study is that it could be used more widely across industries and various sizes of companies, funds, and other trading instruments.

Keywords: *Moving average convergence divergence (MACD), Technical Analysis, Signal and Profit relation, Stock Market Trading, Profitability*

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1. INTRODUCTION

Is it because technical analysis doesn't have good coverage in academia or because most of the traders follow fundamental analysis superstars such as Warren Buffet, but technical analysis is getting very little attention. In recent years, fueled with non-fundamental base commodities trading, technical analysis picks up on popularity.

In certain markets technical analysis can provide much more input than fundamental analysis, and it is usually said that where fundamental stops, technical analysis continues as it is based purely on the relationship between supply and demand and not so much on the financial character of the traded instrument.

2. LITERATURE REVIEW

What technicians (popular title of technical analysis masters) claim is that indicating ratios, dividend growth model, Black and Scholes model and other popular financial models mean nothing if there is no supply and demand (STOFT, 2002; EDWARDS; MAGEE, 2007).

One of the many available tools of technical trading is something popularly called MACD or Moving Average Convergence Divergence. MACD is known as the most valuable tool in a technician's toolbox and without it most of technical analyses would be impossible.

MACD was developed by a legendary technician mr Gerard Appel who turned his obsession for so called momentum indicators into a MACD as we know it today (Murphy, 2004). MACD actually consists of two lines that are comprised of three moving averages. First one is called MACD line (usually color blue) and the other one is called 'the signal line', usually red color (APPEL, 1979). MACD line is derived as follows:

MACD line =12day Exponential Price average – 26day Exponential Price average (1)

12day exponential price average, minus, 26day exponential price average,

SIGNAL line = 9day exponential average of MACD line (2)

while the "signal" line is derived as a 9day exponential average of MACD line. This 12/26/9 is a standard and at the same time 'original recipe' combination of

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periods, some technicians decide to modify this original combination and make their own, customized combinations.

The 12/26/9 setting got set during 1970s when the standard work week was 6 days, so in effect 12 represents 2 weeks, 26 represents a full month and 9 represents week and a half therefore covering the entire months length. With the arrival of the new customizable and interactive tools, one can easily change the original 12/26/9 structure into something that is a better 'fit' for the investment instrument being analyzed (SHANNON, 2008).

Since the formula is dealing with the 12, 26, and 9 day exponential average it is important to say that exponential moving average is a type of weighted average or an average where some periods, or in this case days, carry more 'weight' than others. For example when a 9 day exponential moving average is calculated, the most recent day is carrying most weight while the day before the most recent day is carrying little bit less weight and so on, to the 9th day that is carrying the least weight therefore placing more importance on the most recent days. (PRADIPBHAI, 2013; NISON, 2001). Exponential average is calculated as:

$$EP(t) = \alpha * P(t-1) + (1 - \alpha)*EP(t-1) \quad (3)$$

where α is a coefficient of the division of the weight, P(t-1) is the price of the stock at the trading close of the previous day, and EP(t-1) is an exponential average calculated for the previous day. Two of the MACD lines cross over each other and the important events are when two lines cross above or below the central or so called 'zero' line.

MACD became highly valued among traders because it becomes extremely powerful especially when for example a strong buy signal is coupled with an increase in the trading volume (DHARAMVEER, 2014; PRING, 1995). On the following chart we see a number of crossovers between MACD and signal lines and each of those crossovers can give a buy signal.

The signal strength (in this research I measure it from 1 to 10, from weakest to strongest, respectively) depends on the position where the crossover happens. Deeper below the zero line the crossover happens, the stronger the buy signal it is.

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So, if the crossover happens on or around the zero line, the signal strength is 1 and if the crossover happens on or around the -6 line the signal strength is 10. For example the first circled crossover happened at the level '-3' so the signal strength would be a '6', while the second circled crossover happened at the level '-1' so the signal strength would be a '2'.

Graph 1: MACD and crossovers

3. HYPOTHESIS

The research title alone dictates the logical hypothesis. Key point is to prove or disprove that by using the MACD it is possible to generate investment profit. From this the main hypothesis is derived:

"…With MACD usage as a stock investment indicator, it is not possible to generate a consistent, considerable and sustainable profit…"

This basically means that if the relation between generated profit yield and a signal strength derived by MACD, is not in direct proportion, it means that MACD when used as a standalone investment decision maker does not produce consistent or sizeable profit.

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The validity of the hypothesis will be determined by the correlation coefficient ('r') or Pearson's 'r', as well as 'r2' which is the coefficient of determination. If it proofs that the above-mentioned coefficients are rather high or much closer to 1 than to 0, then we can conclude that the hypothesis 'stands', while if opposite happens, the hypothesis 'falls'.

4. METHODOLOGY

The research methods used in this research basically include tracking of the trading history of the chosen firms in the timeframe from September 2008 to September 2013, as well as uncovering the relationship between the signal strength of MACD and the profitability in case the investor reacts on the given signal. This research will dissect collected 5year data about the three companies and try to prove or disprove the hypothesis.

The percent profit yield will be calculated based on the signal of the MACD and the yield will be compared to the strength of the signal given by MACD, so in effect the analysis will portray yield as a dependable variable while MACD signal strength will be depicted as an undependable variable and in the end the connection between those variables will be analyzed by statistical regression.

4.1. Data Analysis and Discussion

As mentioned before for each generated MACD signal, a strength level will be assigned from 1-10 (weakest – strongest). On the graph 2, shown below we have the depiction of the price movements of Amazon Inc., and below the price movements, MACD indicator is plotted out. In the given period of 5 years (from 2008-2013), Amazon's MACD generated a total of 17 signals that are shown on the graph 2. The price movement generally has a positive slope with the tendency to continue rising.

There have been some periods of retraction especially in September/October 2011 and after that MACD confirmed a good opportunity to go long with its strong buy signal.

Signal strengths are of a solid distribution ranging from 2-10.

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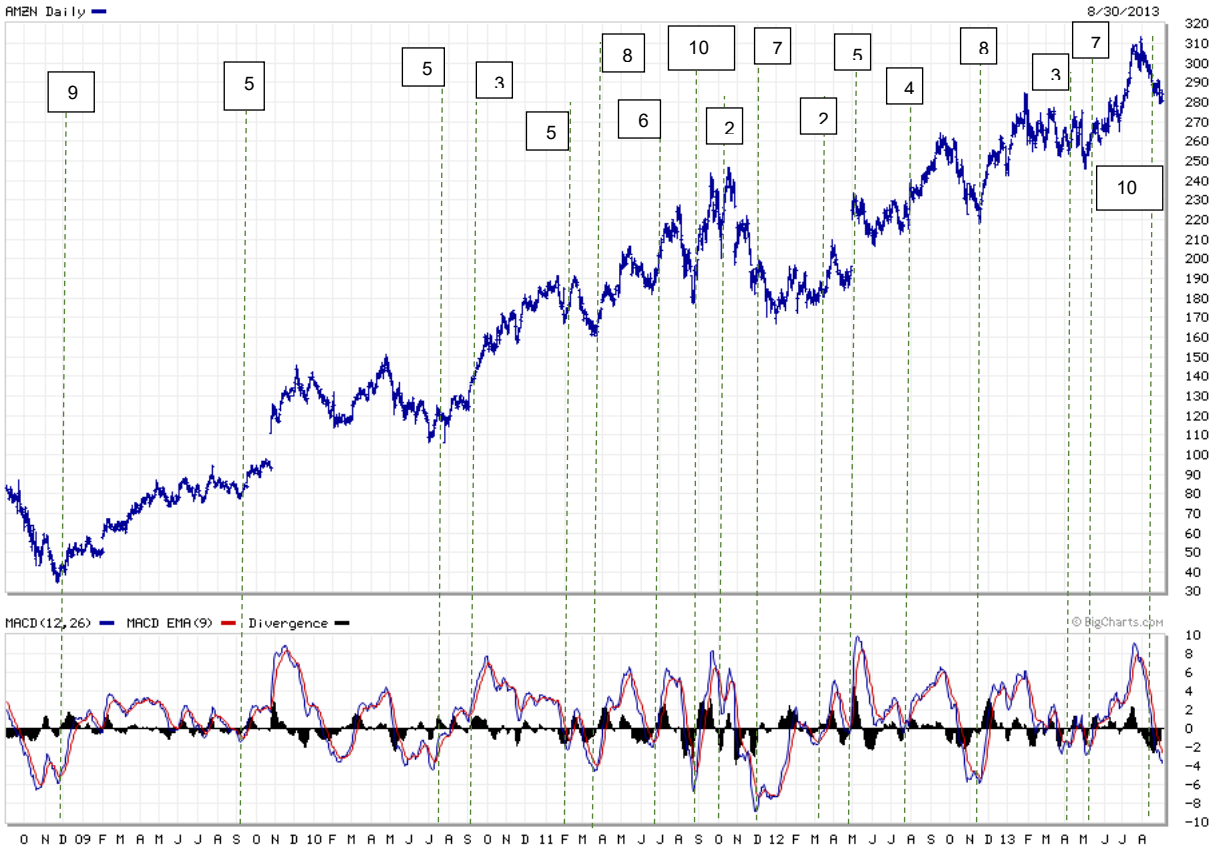

Graph 2: Amazon Inc daily trading over 5 years including MACD

On the graph 3, shown below we have the depiction of the price movements of Apple Corp, and below the price movements, MACD indicator is plotted out. In the given period of 5 years (from 2008-2013), Apple's MACD generated a total of 19 signals that are shown on the graph 3.

The price movement generally has a positive slope with the tendency to correct itself downwards. What is very interesting is the fact that Apple has touch-tested a psychological ceiling at $100 and as soon as it touched it the sell-off began.

Signal strengths are of a solid distribution ranging from 2-10.

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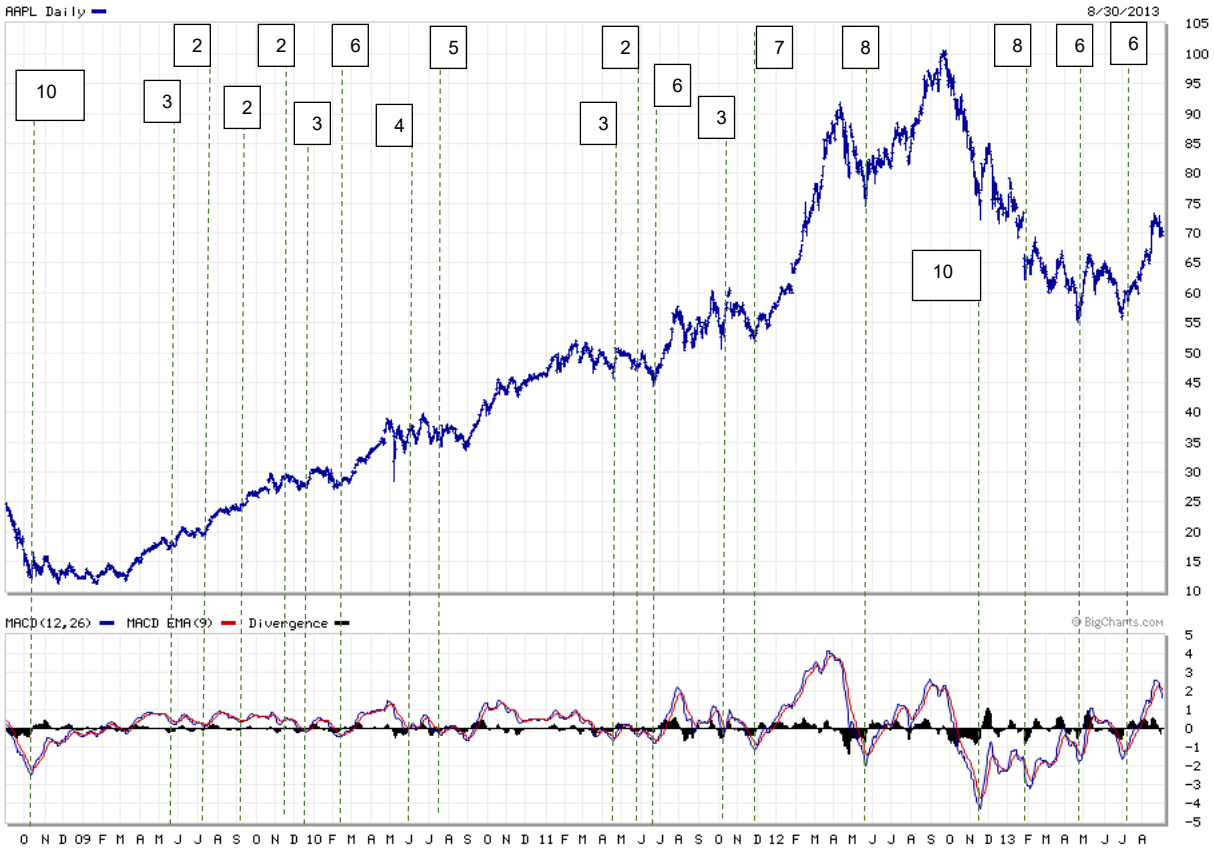

Graph 3: Apple Corp daily trading over 5 years with MACD

On the graph 4, shown below we have the depiction of the price movements of IBM Corporation, and below the price movements, MACD indicator is plotted out. In the given period of 5 years (from 2008-2013), IBM's MACD generated a total of 16 signals that are shown on the graph 4.

The price movement generally has a positive slope with the tendency to generally continue rising. There is a very good chance that the price will hit a very hard and psychological ceiling at $200 per share as this resistance has been tested at least 5 times in the past 6 months.

If the price penetrates the given ceiling and since it was tested on so many occasions, if the price goes north of $200, than $200 level will become a super strong floor which would represent a good opportunity for a long term investment.

Signal strengths are of a solid distribution ranging from 3-10.

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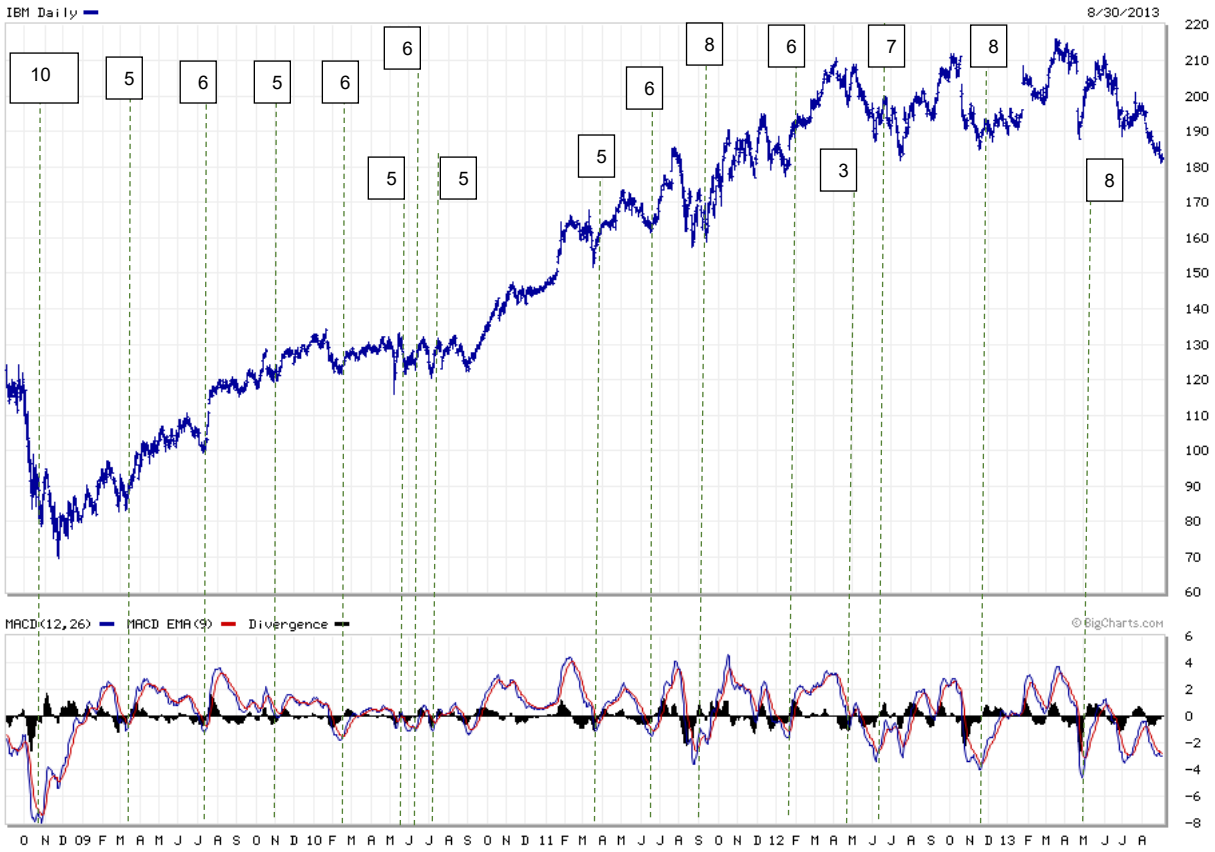

Graph 4: IBM daily trading over 5 years including MACD

A tabular representation of MACD signals for all three companies, their strengths and corresponding profit margins are shown in the table 1. This table shows all the details such as the date of the signal, price when signal was generated, the actual signal strength and the profit margin that corresponds to the given signal.

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Table 1: tabular depiction of signal strengths and trades for Amazon, Apple and IBM

	Date	Stock Price	MACD		Date	Stock Price	MACD		Date	Stock Price	MACD
AMZN	12/22/2008	49.84	9	AAPL	10/15/2008	97.95	10	IBM	10/29/2008	88.20	10
	6/29/2009	83.03	67%		4/20/2009	120.5	23.02%		2/17/2009	90.67	2.80%
	10/12/2009	93.6	5		6/1/2009	139.35	3		3/13/2009	90.36	5
	1/11/2010	130.31	39%		6/11/2009	139.95	0.43%		4/15/2009	98.85	9.40%
	8/9/2010	128.83	5		7/16/2009	147.52	2		7/17/2009	115.42	6
	11/23/2010	168.2	3		8/11/2009	162.83	10.38%		8/10/2009	118.70	2.84%
	12/7/2010	176.77	5%		9/14/2009	173.72	2		11/6/2009	123.49	5
	1/24/2011	176.85	37%		10/1/2009	180.86	4.11%		11/27/2009	125.70	1.79%
	2/8/2011	183.06	5		11/10/2009	202.98	2		2/16/2010	125.23	6
	2/23/2011	176.68	-3%		11/19/2009	200.51	-1.22%		3/29/2010	128.59	2.68%
	3/24/2011	171.1	8		12/21/2009	198.23	3		5/11/2010	126.89	5
	4/18/2011	178.34	4%		1/13/2010	210.65	6.27%		5/20/2010	123.80	-2.44%
	6/21/2011	194.23	6		2/12/2010	200.38	6		6/11/2010	128.45	6
	7/15/2011	212.87	10%		3/24/2010	229.37	14.47%		6/24/2010	128.19	-0.20%
	8/26/2011	199.27	10		6/14/2010	254.28	4		7/8/2010	127.97	5
	9/26/2011	229.85	15%		6/29/2010	256.17	0.74%		7/20/2010	126.55	-1.11%
	10/12/2011	236.81	2		7/22/2010	259.02	5		3/22/2011	158.00	5
	10/21/2011	234.78	-1%		8/6/2010	260.09	0.41%		5/6/2011	168.89	6.89%
	12/5/2011	196.24	7		4/14/2011	332.42	3		6/17/2011	164.44	6
	2/2/2012	181.72	-7%		5/4/2011	349.57	5.16%		8/1/2011	180.75	9.92%
	3/22/2012	192.4	2		5/25/2011	336.78	2		8/25/2011	165.58	8
	4/5/2012	194.39	1%		6/3/2011	343.44	1.98%		10/18/2011	178.90	8.04%
	4/26/2012	195.99	5		6/27/2011	332.04	6		1/20/2012	188.52	6
	5/15/2012	224.39	14%		8/4/2011	377.37	13.65%		2/14/2012	192.22	1.96%
	7/30/2012	236.09	4		10/12/2011	402.19	3		4/26/2012	205.58	3
	9/21/2012	257.47	9%		10/21/2011	392.87	-2.32%		5/9/2012	201.23	-2.12%
	11/19/2012	229.71	8		11/30/2011	382.2	7		6/8/2012	195.14	7
	12/17/2012	253.86	11%		3/8/2012	541.99	41.81%		8/23/2012	195.70	0.29%
	4/1/2013	261.61	3		5/25/2012	562.29	8		11/19/2012	190.35	8
	4/19/2013	260.32	-0.49%		7/24/2012	600.92	6.87%		2/8/2013	201.68	5.95%
	5/8/2013	258.68	7		11/16/2012	527.68	10		5/3/2013	204.51	8
	6/21/2013	273.36	6%		12/10/2012	529.82	0.41%		6/5/2013	202.74	-0.87%
	8/29/2013	283.98	10		2/13/2013	467.01	8				
	9.31.2013	319.04	12.35%		4/3/2013	431.99	-7.50%				
					4/29/2013	430.12	6				
					6/6/2013	438.46	1.94%				
					7/11/2013	427.29	6				
					8/27/2013	488.59	14.35%				

A truncated table showing only the signal strength and the corresponding profit margin is shown in the table 2.

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Table 2: Truncated table showing signal strength and corresponding profit margins

AMZN		**AAPL**		**IBM**	
Signal	Profit	Signal	Profit	Signal	Profit
9	67.00	10	23.02	10	2.80
5	39.00	3	0.43	5	9.40
5	37.00	2	10.38	6	2.84
3	5.00	2	4.11	5	1.79
5	-3.00	2	-1.22	6	2.68
8	4.00	3	6.27	5	-2.44
6	10.00	6	14.47	6	-0.20
10	15.00	4	0.74	5	-1.11
2	-1.00	5	0.41	5	6.89
7	-7.00	3	5.16	6	9.92
2	1.00	2	1.98	8	8.04
5	14.00	6	13.65	6	1.96
4	9.00	3	-2.32	3	-2.12
8	11.00	7	41.81	7	0.29
3	-0.50	8	6.87	8	5.95
7	6.00	10	0.41	8	-0.87
10	12.35	8	-7.50		
		6	1.94		
		6	14.35		

4.2. Findings

Using the above tables, usable dataset is created and it can be used for the statistical tests that will numerically prove or disprove the hypothesis.

Table 3: Paired Sample Test

		Paired Differences					t	df	Sig. (2-tailed)
		Mean	Std. Deviation	Std. Error Mean	95% Confidence Interval of the Difference Lower	Upper			
Pair 1	AMZprofit - APLprofit	-.3058	20.723	5.98245	-13.47312	12.86145	-.051	11	.960
Pair 2	AMZprofit - IBMprofit	9.6109	13.085	3.94528	.82027	18.40155	2.436	10	.035
Pair 3	APLprofit - IBMprofit	6.1590	15.064	4.54201	-3.96114	16.27933	1.356	10	.205

The profit yields and signal strength of three chosen companies, Amazon, Apple and IBM, were analyzed using paired sample t test.

The paired t-test is used when each observation in one group is paired with a related observation in the other group. In this case profit yields in relation to signal

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strength of one company are paired to that of another company, e.g. Amazon profit yields are paired with profit yields of Apple and IBM.

Table above demonstrates the results of paired sample t test for three chosen companies. The p-value (level of significance) for pair 2 Amazon Profit-IBM Profit is 0,035 what is lower than 0,05, so the null hypothesis will be rejected. There exists significant difference in profit yields in relation to signal strength, between Amazon and IBM.

According to the table results, the remaining two pairs, pair 1 and 3, the difference between companies (Amazon-Apple and Apple-IBM), is not statistically different form zero.

Besides using Paired Sample Test, the regression tool is also used in order to explain the strength of the relationship between independent variable (signal strength) and dependent variable (profit margin).

The relationship between the two variables will be mainly explained by a coefficient of determination or r2. R2 is a statistical measure of how close the data are to the fitted regression line. Coefficient of Determination is calculated as Explained variation / Total variation

R2 is a number that is always between 0 and 100%:

- 0% indicates that the model explains none of the variability of the response data around its mean.
- 100% indicates that the model explains all the variability of the response data around its mean.

Table 4: Correlations

		Profit	Signal
Pearson Correlation	Profit	1.000	.168
	Signal	.168	1.000
Sig. (1-tailed)	Profit	.	.117
	Signal	.117	.
N	Profit	52	52
	Signal	52	52

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Pearson correlation measures the strength and direction of the linear relationship between the two variables. The Pearson correlation between profit yields and signal strength is 0.168, which means that there is no strong correlation between profit yields and signal strength in relation to MACD indicator.

Table 5: Model Summary

Model Summary[b]							
Adjusted R Square	Std. Error of the Estimate	Change Statistics					Durbin-Watson
		R Square Change	F Change	df1	df2	Sig. F Change	
0.009	10.181	0.028	1.453	1	50	0.234	1.627

R^2 describes the proportion of variance in the dependent variable (profit yields) which can be explained by the independent variables (signal strength). It is an overall measure of the strength of association and does not reflect the extent to which any particular independent variable is associated with the dependent variable. In this case, R^2 is 0.028, what means that just 2.8% of variance in profit yields can be described by the signal strength which is related only to the MACD indicator.

Table 6 - Standardized and Unstandardized Coefficients

Model		Unstandardized Coefficients		Standardized Coefficients		
		B	Std. Error	Beta	t	Sig.
1	(Constant)	2.348	3.654		.643	.523
	Signal	.718	.596	.168	1.205	.234

a. Dependent Variable: Profit

B Coefficient - These are the values for the regression equation for predicting the dependent variable from the independent variable. From the table above, we can see that the B coefficient for independent variable – signal strength is 0.718, what means that for every unit of increase in signal strength, it is predicted that the profit yield will increase for 0.718. However, the corresponding p-value is 0.234 which is higher than 0.05, what means that coefficient for signal strength is not significantly different from zero.

5. CONCLUSION

Based on the above research and analysis, the conclusion is that the hypothesis "…With MACD usage as a stock investment indicator, it is not possible to generate a consistent, considerable and sustainable profit…" stands, as the

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statistical tools have shown that the relationship between signal strength and the generated profit is very weak.

This applies mainly to young and upcoming investors who are lured mainly by FOREX brokers who claim that huge profits can be made using 'a simple but proven tool called MACD'. Investments in any kind of financial instruments must be based on multiple indicators and even if all selected indicators 'agree' on the signal, the investor should be cautious and protect themselves via stops, hedging or other loss-prevention techniques.

The limitations of this paper come mainly in the form of the lack of width across industries and across the markets as it would be interesting to see does the same thing happen over the World's markets and different industries. These limitations can serve as a 'seed' and as a igniter for the upcoming graduates and master and PhD candidates who could develop and drill-down this topic fatherly.

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